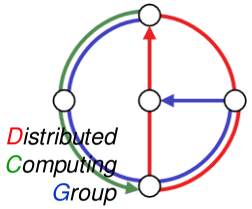
DISCRETE EVENT SYSTEMS



Roger Wattenhofer
Winter 2004 / 2005

Organization Matters

- Lecture
  - Thu, 1-3, ETA F5
  - Roger Wattenhofer
- Exercises
  - Thus, 3-5, ETA F5
  - Thomas Moscibroda, Stefan Schmid
- Course Material
  - Check www.dcg.ethz.ch → courses Go

Course Overview

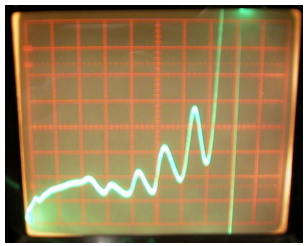
- Part 1: Theory of Coke Vending Machines
  - Automata and Languages
  - Discrete Event Systems (DES) Models
- Part 2: Theory of Standing in a Line
  - Stochastic Processes
  - Markov Chains, Queuing Theory
  - Average-Case Analysis of DES
- Part 3: Theory of Renting Skis
  - Online Algorithms
  - Worst-Case Analysis of DES
- Plus a few smaller parts

Some Comments

- English vs. German language
- First-timer for me: On-the-fly preparation of course material (sorry!)
  - Slides/material on web site before lecture…
- Differences to last year's course
  - A bit less petri nets, a bit less systems
  - Maybe a bit more theoretical… (sorry again!?)
  - Still I adopted some slides from Lothar Thiele and Thomas Erlebach
- EE vs. CS students…

Motivation: Physics

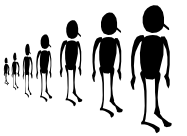
- Science is often based on natural phenomena
- Laws of physics: mechanics, gravitation, electrodynamics
- Continuous variables for mass, velocity, power, etc.
- Can be solved by differential equations



Motivation: Discrete Events

- Some complex systems are not [primarily/only] continuous
  - Computer systems
  - Communication networks
  - Business processes ("workflow")
  - Transportation systems
  - Software

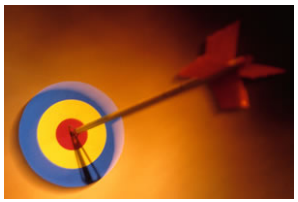
- Instead systems are determined by discrete events
  - Telephone calls
  - Customers arrivals



- Many variables we are interested in are discrete
  - How many ...?

Motivation: Discrete Event Systems

- System models
  - Find the right level of detail to model a real system
  - "Make everything as simple as possible, but not simpler"
- Correctness verification
  - Formal specification
  - Testing
  - Simulation
- Analysis and Optimization



Literature

- Christos G. Cassandras, Stephane Lafortune. Introduction to Discrete Event Systems. Kluwer Academic Publishers, 1999.
- Part 1
  - Michael Sipser. Introduction to the Theory of Computation. PWS Publishing, 1997. (Chapters 1 and 2)
- Part 2
  - Dimitri Bertsekas, Robert Gallager. Data Networks. Prentice Hall, Upper Saddle River, NJ, 1992. (Chapter 3)
  - Thomas Schickinger, Angelika Steger: Diskrete Strukturen, Band 2. Springer, 2001. (Chapters 1, 2, and 4)
- Part 3
  - Allan Borodin, Ran El-Yaniv. Online Computation and Competitive Analysis. Cambridge University Press, 1998. (Selected Chapters)
- Plus lots of research papers…